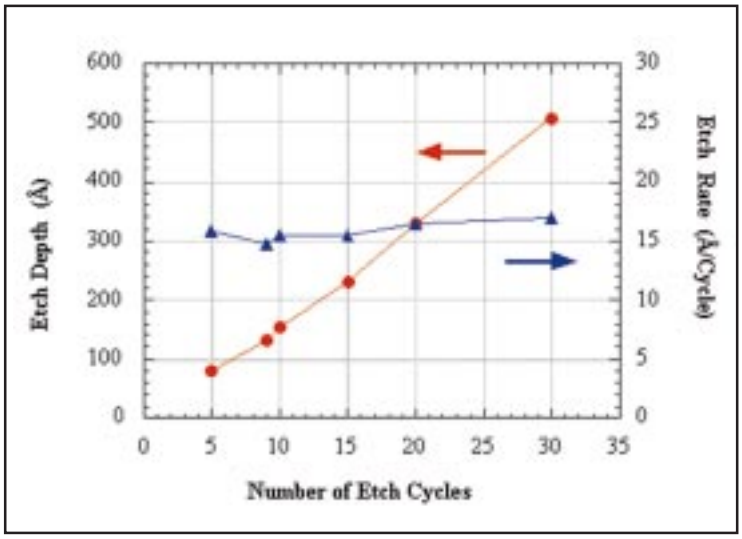
New Digital Etching Technology Improves Semiconductors



Payoff

The new wet digital etching process, (patent pending) can controllably remove semiconductor material at the atomic layer level. This ability to remove such small amounts of material will enable better control and precision in semiconductor device fabrication, as device geometrics continue to shrink.

Accomplishment

Scientists from the Sensor Directorate invented a wet chemical digital etching technique for fabricating transistors which improves the process control and helps to optimize semiconductor device performance. Their digital etching process for gallium arsenide precisely removes material with precision approaching several atomic layers, and without time constraints associated with other etching techniques. This technique uses standard wet chemicals and does not require sophisticated equipment, so it can be easily incorporated into current manufacturing processes.

Background

Over the years, semiconductor manufacturing techniques have been improved upon to enhance the yield of semiconductor devices and circuits. At the same time, integrated circuit and device geometrics have been getting smaller to improve their operating speeds. While material growth techniques have demonstrated the ability to grow semiconductor layers with atomic layer precision, etching techniques have not matched this progress. To take advantage of the material growth technology, a manufacturable etching process must also have the ability to remove material with atomic precision to obtain the full benefit of these device structures. As an example, the gate recess etch in semiconductor field effect transistor fabrication is the most critical step in the manufacturing process. The Sensor Directorate's digital etching technique, using current wet etching technology, consists of a two-step process to remove a fixed thickness of material. Repetition of this two-step process is used to obtain the desired etch depth in integral multiples of the depth achieved by a single digital etch cycle. The first step of a digital etch cycle uses a chemical reaction to form a thin layer of a new molecular compound on the semiconductor surface (e.g., an oxide). Because this chemical reaction is diffusion limited, the thin layer will have a constant thickness for each cycle. In the second step, another chemical reaction is used to selectively remove the newly formed compound layer from the surface without affecting the unreacted semiconductor material underneath. Wet chemical digital etching does not require the use of sophisticated equipment and can be easily incorporated into an existing manufacturing process.